

# Barnes Infant Academy



## Calculation Policy



## **Principles of the Policy**

One of the key learning principles behind this policy is the concrete pictorial abstract approach (CPA). The concrete-pictorial-abstract approach, is based on research by psychologist Jerome Bruner, and suggests that there are three steps (or representations) necessary for children to develop understanding of a concept.

For children to have a deep understanding of the mathematical concepts being developed, they need to 'master' all three phases of the CPA approach. If a child has moved on from the concrete to the pictorial, it does not mean that the concrete cannot be used alongside the pictorial as an additional scaffold. If a child is working at the abstract stage, 'proving' something or 'working out' then concrete or pictorial representations could be used to develop a greater depth as pupils articulate their thinking /reasoning. Reinforcement is achieved by going back and forth between these representations. Linking abstract notation to pictorial/concrete representations and then the concrete/pictorial models to an abstract notation.

### **Concrete Representation**

The ***enactive stage***. Children are first introduced to an idea/skill/concept by acting it out with real objects, this could include large scale with the pupils themselves and also utilise resourced available in the outdoor environment. This is a '***hands on***' stage using real objects linked to real-life and the wider curriculum and/or mathematical equipment, (i.e. counters, cubes, bead string, five and ten frames, Dienes, place value counters etc.) and it is the foundation for ***CONCEPTUAL UNDERSTANDING***.

### **Pictorial Representation**

The ***iconic stage***. A child has sufficiently understood the hands-on, ***CONCRETE*** experiences performed and can now relate them to ***PICTORIAL*** representations, such as a ***DIAGRAM*** or ***PICTURES*** of the problem. ***PICTORIAL*** representations, such as the bar model, can also be used to ***scaffold*** understanding.

### **Abstract Representation**

The ***symbolic stage***. A child is now capable of representing problems by using ***ABSTRACT*** mathematical notation, for example:  $12 \div 2 = 6$ . This is the ultimate mode.

Teachers should understand how each stage of the CPA approach can be used effectively to ***MODEL*** concepts, ***SCAFFOLD*** learning and ***RECORD*** thinking:

***MODELLING***: teachers to make clear links are made between ***CONCRETE*** representations (which can also be represented pictorially), ***PICTORIAL*** representations (diagrams and pictures, including bar modelling) and ***ABSTRACT*** notations.

***SCAFFOLDS***: children to be offered the opportunity to use appropriate ***CONCRETE*** and ***PICTORIAL*** representations to further ***scaffold*** their understanding. The ***scaffolds*** offered, must be familiar and understood by children. Children should be encouraged to consider whether ***scaffolds*** are required and for how long they require them for. ***CONCRETE*** and ***PICTORIAL*** representations are also supportive when developing children's depth of knowledge through problem solving and reasoning experiences.

**CONCRETE RECORDING:** when children are unable to *record* their thinking using **PICTORIAL** representation or **ABSTRACT** notation then their learning can be evidenced through photographic evidence and post-it notes, which detail key information regarding children's strengths and areas of developments/gaps/misconceptions.

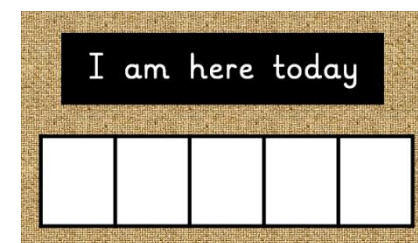
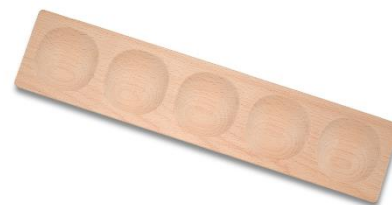
**PICTORIAL RECORDING:** children to be encouraged to represent their thinking using **PICTORIAL** representations, if they are unable to record using **ABSTRACT** notation. **PICTORIAL** representation also includes the use of the bar model.

**ABSTRACT RECORDING:** this is the ultimate mode but should not be rushed at the expense of true **CONCEPTUAL UNDERSTANDING**. Scaffolds, such as missing box calculations, can support children's transition towards **ABSTRACT**.

The following manipulatives support our CPA approach. To ensure progression, each year group builds upon the equipment used in the previous years. This is not an exhaustive list.

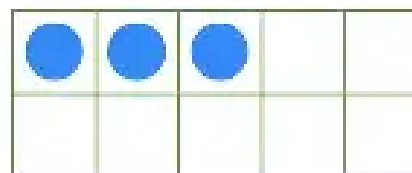
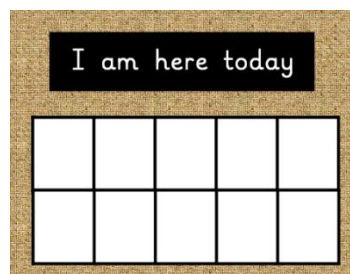
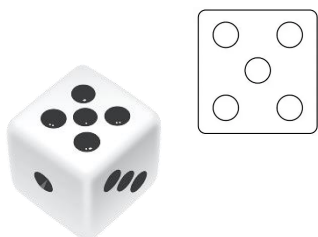
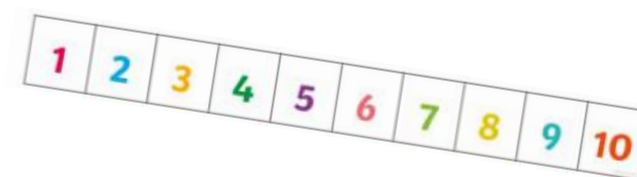
### Nursery

- Natural and everyday objects
- Items linked to counting rhymes
- Items used in play
- 5 frames



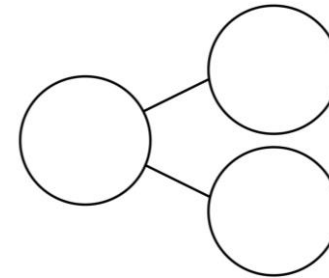
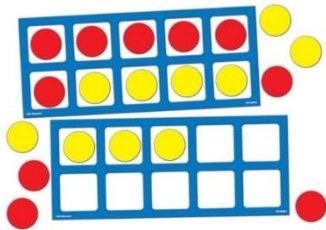
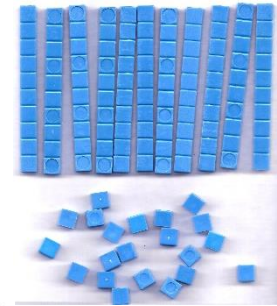
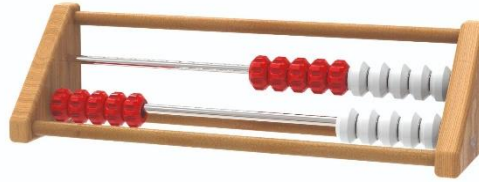
### Reception

- Interlocking cubes
- Hungarian dice frames
- Tens frames and counters
- Numicon
- Number track



## Year 1

- Tens frames and two-sided counters
- Rekenrek
- Base 10, *tens and ones*
- Part Whole Model
- Number lines
- Number squares



## Year 2

- In Year 2, the children focus on using the manipulatives they have already been introduced to, in order to explore addition and subtraction within 100.
- With regards to multiplication and division, resources are used to explore grouping, sharing and creating arrays.

91	92	93	94	95	96	97	98	99	100
81	82	83	84	85	86	87	88	89	90
71	72	73	74	75	76	77	78	79	80
61	62	63	64	65	66	67	68	69	70
51	52	53	54	55	56	57	58	59	60
41	42	43	44	45	46	47	48	49	50
31	32	33	34	35	36	37	38	39	40
21	22	23	24	25	26	27	28	29	30
11	12	13	14	15	16	17	18	19	20
1	2	3	4	5	6	7	8	9	10